

CLAIMS

1. A method of glucose level control, comprising:
5 providing at least one electrode adapted to apply an electric field to a pancreas; and
applying an electric field to the pancreas using said at least one electrode such that
blood glucose levels are significantly reduced and blood insulin levels are not significantly
increased.
- 10 2. A method according to claim 1, comprising subsequently applying a second electric
field to said pancreas, which second field increases insulin levels.
3. A method according to claim 1, wherein said electric field is operative to reduce
glucagon secretion.
- 15 4. A method according to claim 1, wherein said electric field is operative to reduce
glucose secretion by a liver physiologically coupled to said pancreas.
5. A method according to claim 1, wherein said electric field is operative to increase
20 glucose uptake by cells in a body containing said pancreas.
6. A method according to claim 1, wherein said electric field is operative to affect
nervous tissue in said pancreas.
- 25 7. A method according to claim 1, wherein said electric field is non-excitatory in that it
does not substantially induce new bursts of islet activity in said pancreas.
8. A method according to claim 1, wherein said electric field is applied as a bi-phasic and
charge balanced time varying field.
- 30 9. A method according to claim 8, wherein said electric field is applied for a short
duration every period of time.

10. A method according to claim 9, wherein said period of time gives an application frequency of between 1Hz and 15 Hz.
11. A method according to claim 9, wherein said period of time gives an application
5 frequency of about 5 Hz.
12. A method according to claim 9, wherein said duration is less than 30 ms.
13. A method according to claim 9, wherein said duration is about 10 ms.
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14. A method according to claim 1, wherein said electric field is repeated for a period of less than 30 minutes.
15. A method according to claim 1, wherein said electric field is repeated for a period of
15 between 30 and 180 minutes.
16. A method according to claim 1, wherein said electric field is applied for substantially all of a duration of a glucose absorption event.
- 20 17. A method according to claim 1, wherein said electric field is applied prior to an expected glucose ingestion event.
18. A method according to claim 1, comprising triggering said electric field by a glucose ingestion event.
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19. A method according to claim 1, wherein said electric field is applied irrespectively of an ingestion event.
20. A method according to claim 1, wherein said electric field is applied at least part of the
30 time irrespectively of a blood glucose level.
21. A method according to claim 1, wherein said electric field is applied continuously for at least 24 hours.

22. A method according to claim 1, wherein said electric field is applied for a period of at least 15 minutes without sensing of its effect.
23. A method according to claim 1, wherein said electric field is of a magnitude and temporal extent so that it does not significantly change blood insulin and glucose levels in the absence of an ingestion event.
24. A method according to claim 1, wherein said electric field reduces blood glucose levels by at least 20% of an elevation of the glucose level above a fasting baseline glucose level.
25. A method according to claim 1, wherein said electric field does not increase blood insulin levels, as measured by an average over five minutes, by more than 20%.
26. A method according to claim 1, comprising, delaying a gastric emptying by applying a treatment to the stomach.
27. A method according to claim 1, wherein said electric field is operative to delay a glucose peak at least by a duration of its application.
28. A method according to claim 1, wherein said electric field is operative to delay a glucose peak at least by 10 minutes.
29. A method according to claim 1, wherein said electric field is operative to delay an insulin peak at least by 10 minutes.
30. A method of glucose level control, comprising:
providing at least one electrode adapted to apply an electric field to a pancreas; and
applying an electric field to the pancreas operative to reduce blood glucose levels if elevated and not significantly reduce such levels if not substantially elevated.
31. A method according to claim 30, wherein said electric field reduces elevated glucose levels by at least 20%.

32. A method according to claim 30, wherein said electric field does not reduce unelevated glucose levels by more than 10%
33. A method according to claim 30, wherein said electric field does not impair exocrine
5 functions of said pancreas.
34. Apparatus for blood glucose control, comprising:
at least one electrode adapted to apply an electric field to a pancreas; and
circuitry adapted to electrify said at least one electrode and configured to electrify said
10 electrode in a manner which compensates for a loss of acute response by said pancreas.
35. Apparatus according to claim 34, wherein said circuitry compensates by causing the secretion of an insulin bolus.
- 15 36. Apparatus according to claim 34, wherein said circuitry compensates by reducing glucose levels in a non-insulin manner.
37. Apparatus according to claim 36, wherein said circuitry compensates by reducing glucagon secretion.
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38. Apparatus according to claim 34, wherein said circuitry reduces or prevents a substantial increase in insulin secretion during said compensation.
39. Apparatus according to claim 34, wherein for at least 20% of ingestion events said
25 circuitry applies only an acute control of insulin levels.
40. Apparatus according to claim 39, wherein said apparatus is programmed with a knowledge of a slow acting chemical-based insulin therapy provided to said pancreas.
- 30 41. Apparatus according to claim 34, comprising an automatic ingestion sensor for automatically detecting an ingestion event.
42. Apparatus according to claim 34, comprising an automatic glucose sensor for automatically detecting a situation requiring an acute response.

43. Apparatus according to claim 34, comprising an automatic glucose sensor for automatically detecting a situation requiring an acute insulin response.
- 5 44. Apparatus according to claim 34, wherein said response is an acute insulin response.
45. Apparatus for blood glucose control, comprising:
at least one electrode adapted to apply an electric field to a pancreas; and
circuitry adapted to electrify said at least one electrode and configured to electrify said
10 electrode in a manner which significantly reduces elevated blood glucose levels, said circuitry
configured to apply said field also when glucose levels are not elevated.
46. Apparatus according to claim 45, wherein said circuitry is a closed loop system
including sensing of the effect of the electrification and wherein said circuitry is configured to
15 over stimulate in cases of doubt.
47. Apparatus according to claim 45, wherein said circuitry is a semi-open loop system
where a relatively long stimulation series is applied without feedback.
- 20 48. Apparatus according to claim 45, wherein said circuitry is an open loop system where a
stimulation series is applied responsive to a trigger and without feedback.
49. Apparatus for blood glucose control, comprising:
at least electrode adapted to apply an electric field to pancreatic tissue; and
25 circuitry adapted to electrify said at least one electrode and configured to electrify said
electrode in a manner which reduces glucose levels and does not substantially elevate insulin
levels above a baseline value, when glucose levels are elevated.
50. Apparatus according to claim 49, wherein said circuitry is a closed loop system
30 including sensing of the effect of the electrification and wherein said circuitry is configured to
over stimulate in cases of doubt.
51. Apparatus according to claim 49, wherein said circuitry is a semi-open loop system
where a relatively long stimulation series is applied without feedback.

52. Apparatus according to claim 49, wherein said circuitry is an open loop system where a stimulation series is applied responsive to a trigger and without feedback.
- 5 53. Apparatus according to claim 49, wherein said circuitry applies a constant voltage field.
54. Apparatus according to claim 49, wherein said circuitry applies a constant current field.
- 10 55. Apparatus according to claim 49, wherein said pancreatic tissue comprises an in-vivo pancreas.
56. Apparatus according to claim 49, wherein said pancreatic tissue comprises a pancreatic
15 tissue implant.